Johnstone, Professor James, D.Sc. *The Essentials of Biology*. London, 1932. Edward Arnold. Pp. xv+328. Price 16s.

THE author of this book, like the majority of the educated public in general, is much impressed with the surprising results of recent research in physical science. He points out how little the revolutionary experimental methods and the new concepts of speculative physics have affected either practical or speculative biology. He believes that the next important advance in biological science will be due to the application of the new discoveries in physics to the problems of life. In the meantime he discusses especially in this book the relation of the classical concept of entropy, which still survives when so many others have become obsolete, to the speculative biology of to-day.

Professor Johnstone insists, as in a previous publication, that life involves a local retardation of the increase of entropy, which is the ultimate result of what he calls the "passage of nature"—that is the movements and processes continually going on in the universe. Solar radiation, under ordinary conditions, when it strikes the earth causes a rise of temperature which is soon lost by diffusion of heat, and its energy is dissipated. When some of the radiation falls on a green plant, it causes the formation of carbohydrate by photosynthesis, and part of the energy is stored as the potential energy of plant tissues. In the vegetable kingdom, therefore, potential energy accumulates and a local retardation of the increase of entropy takes place.

Johnstone considers that this is the distinguishing peculiarity of the organic world, the life of animals, as well as that of plants, being dependent on this potential energy. But part of the solar energy is stored up when it causes the ascent of water vapour from the ocean and its deposit as rain or snow on the mountains and highlands, so that in relation to entropy there is no difference between the falls of Niagara and the life of animals. The essential difference is the difference between chemistry and physics. In the case of Niagara, the matter concerned remains chemically unchanged, namely H_2O. In the case of photosynthesis, the storage of energy is due to chemical processes—H_2O and $C\ O_2$ are decomposed by an endothermic reaction, and $C_x\ (H_2O)_y$ compounds are formed, with subsequent nitrogenous compounds and fats, by the oxidation of which the energy of all vital processes is supplied.

The book is divided into two parts, the first dealing with the individual organism, almost but not quite exclusively the animal, and the second part with the race. It would be impossible within a moderate space to review in detail all the chapters in which the most important points of the various branches of biology are discussed. The most difficult and fundamental problems are those arising from the process of ontogeny and heredity, and the process of evolution. We may confine ourselves to these. The author summarizes the recent history of theories of development from the time of Weismann. The theory of Weismann was that the chromosomes of the nucleus were made up of *ids*, each involving all the characters of the complete organism, and each *id* consisting of the determinants of each separately inheritable organ or character. This theory broke down on the difficulty that there is no evidence of any differentiation of the nuclear elements in cell-division during development, no evidence of the assortment of determinants to the parts determined. On the other hand, the facts of Mendelian heredity show that the segregation of maternal and paternal chromosomes in the maturation of the gametes, and their pairing in fertilization, correspond in the most striking way with the development of either the maternal or the paternal character in the offspring. Thus we reach the concept of Morganism, that the chromosomes are made up of genes in linear series, and that the organism is made up of a combination of characters corresponding to and determined by the genes. But the problem still remains: by what process known to physiology, either biophysical or bio-

chemical, do the genes determine the developing organs and characters?—especially as there is no more evidence of the assortment of the genes than there was of Weismann's determinants.

The gene theory is purely morphological, whereas ontogeny is physiological. Professor Johnstone points out convincingly that what is wanted is a theory in terms of energy and the automatic control of matter and energy. Mr. Needham has maintained that the merit of biochemistry is that it deals with substance, not merely with form; but the chief requirement of biology is a knowledge of the processes going on in the substance, not in the chemist's apparatus, but in the living organism. The organizing agency in development produces the individual with all its differentiated organs and structures, and is at the same time transmitted to numbers, it may be millions, of other ova or sperms capable of producing the same series of processes. There is for this no physical analogy. According to Professor Johnstone, the only analogy possible is that with the operation of a mind which executes a plan previously existing in thought! But actually we know nothing of thought except in association with a highly developed nervous system, and so we are asked to explain an antecedent by its consequent, as though we should say that carbohydrate was the explanation of photosynthesis. Professor Johnstone adopts in essentials the mnemic hypothesis. But the ovum or sperm is not derived from a cell which passed through the process of ontogeny of the parent.

Ontogeny, heredity, and evolution are inseparably connected, the explanation of one would probably involve that of the others. With regard to evolution Professor Johnstone's discussion is more open to objection than the rest of his book. In relation to this problem there are surprising omissions. One, for example, is sexual dimorphism, or the question of sex-limited characters. These are briefly mentioned in the chapter on reproduction and growth, and also the fact that hormones from the sex-glands may affect such characters. But not a word of the significance of this fact for evolution. The problem of the origin of this relation between sex-limited structures, such as the antlers of stags, and the internal secretion of the testes, is not mentioned. The significance of this relation for the secretion of the testes, is not mentioned. and the whole discussion of Lamarckism is unsatisfactory. The author is apparently unaware that the dependence of the normal development of sex-limited characters on hormones from testis or ovary can be rationally explained on the theory that the hypertrophy which constitutes a sex-limited character was due to external stimulus limited to one sex, and applied to tissues bathed by the sex-hormone of that sex, and that the tendency to development in the presence of the same hormone was transmitted to the gametes. A similar argument applies to the relation of metamorphosis—e.g. in Amphibia—to the secretion of the thyroid gland. Professor Johnstone appears to have been more interested in recent advances in physics than in the progress of experimental biology.

Professor Johnstone would probably not claim any special merit in his literary style. His writing is clear and distinct, but not very elegant or attractive. He not only uses unfamiliar terms for old things, but old terms in a new sense, which is apt to lead to confusion and misunderstanding. For example, he writes of variants by acquirement and divides acquirements into adaptations and mutilations. He thus restricts the term adaptation to changes in the individual, whereas it has always been used to connote congenital structural adaptations such as the wings of a bird or a bat, the lungs of a frog, prehensile tails, milk glands of mammals, and countless other organs which are adapted to perform special functions connected with special habits or modes of life.

He also appears to be too much under the influence of more or less obsolete concepts dating from Samuel Butler or even Lamarck himself, and not always to preserve the distinction between the psychological and the

physiological. For example, he mentions in the same category the learning by a dog to open a latch, and the thickening of the epidermis in a man as the effect of friction. He writes that organisms change their structure by inward strivings, which recalls Lamarck's idea that antlers were caused by the determination of the animal spirits to the head. Change of structure in the individual is the physiological response to a physical stimulus, mutations, of course, being excluded.

However, criticism notwithstanding, the book has the great merit of being original. The author shows a wide and deep knowledge of contemporary science and, what is less common, a great power of independent, rational thought. Biology includes so many special branches of which the technical details demand the whole time and attention of the specialist, that there are few who are competent by ability and training to understand the fundamental problems and to discuss their relations to the universe. The study of Professor Johnstone's book will help its readers to form clearer and truer conceptions of the phenomena of life, and to perceive more distinctly the nature of the problems which those phenomena present for explanation.

J. T. CUNNINGHAM.

GENETICAL PSYCHOLOGY

Lawrence, Evelyn M., B.Sc., Ph.D. *An Investigation into the Relation between Intelligence and Inheritance.* (*British Journal of Psychology's* Monograph Supplement No. XVI.) London, 1932. Cambridge University Press. Pp. 80. Price 8s. 6d.

THIS inquiry was undertaken before the appearance in America of the 1928 Year Book of the National Society for the Study of Education, in which several investigations of the same sort are reported. Dr. Lawrence gave intelligence tests to children of two large institutions, one taking only illegitimate children during their first year, the other taking children of any age who are for any reason homeless; other groups of children were tested for purposes of comparison.

The correlation normally found between child's intelligence and parent's social class still appears, even among the children of the former institution who have never known their parents. Separate correlation coefficients are given between father's, mother's, and mid-parent's social class on the one hand, and Simplex and Stanford-Binet I.Q's on the other: all the coefficients are low, but all are positive and nearly all are significant. They are, on the whole, lower, but not much lower, than the correlations between parent's class and child's intelligence found both in earlier inquiries and in Dr. Lawrence's own control groups. This must be taken to show that the tests undoubtedly measure a biological factor, but that the I.Q. is not wholly unaffected by environment. Two other findings, consistent with this conclusion, are that on the one hand there is practically no increase of intelligence in children transferred from the worst possible homes to the very much better environment of the second institution, but that on the other hand there is less correlation between parent's class and child's intelligence where the children have left their homes before the age of three than where they have stayed at home till more than three years old: unfortunately the numbers concerned are too small for this last finding to be taken as certainly significant, as Dr. Lawrence herself points out.

The whole inquiry is very thorough and very cautious. It starts with a remarkably clear statement of the difficulties involved in any attempt to disentangle the factors of heredity and environment, and it ends with a full and up-to-date bibliography.

J. F. DUFF.

MARRIAGE AND SEX

Dickinson, R. L., and Beam, L. *A Thousand Marriages: a Medical Study of Sex Adjustment.* London, 1932. Williams and Norgate; Bail-